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REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY[1]

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 27, 1927.

SIR: I have the honor to transmit herewith a report on the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1927.

Respectfully,

PAUL G. REDINGTON, *Chief.*

Hon. W. M. JARDINE,
Secretary of Agriculture.

PROBLEMS IN WILD-LIFE ADMINISTRATION

The wild life of the country is a heritage that was vital to the welfare of the early settlers, and its perpetuation means much, both economically and esthetically, to the present and future generations of their descendants. Any lover of birds and animals knows full well that these wild creatures clearly appreciate the difference between kind and cruel treatment. Unfortunately, however, they do not have the ability to argue their cause before the bar of public opinion. Forward-thinking individuals, recognizing this fact, have designated certain public defenders, whose duty it is to represent these creatures of the wild in all cases where their rights are in question. These defenders fall into three general groups: (1) Organizations of individuals interested in the welfare of wild life; (2) State governmental organizations; and (3) the Bureau of Biological Survey, cooperating with other interested Federal agencies and all other wild-life defenders.

FUNCTIONS OF WILD-LIFE DEFENDERS

The activities of individual and organized wild-life conservationists are concerned chiefly with the gathering of facts affecting the groups of wild life in which they are interested, the formulation of educational programs, and the supporting of governmental agencies designated as wild-life defenders. Closely cooperating in the solution of problems confronting governmental agencies, State and national, are many scientific societies and institutions, agricultural organizations, and sportsmen's clubs, and many influential national, international, and State conservation associations whose prime object is to preserve for future generations our valuable resources of wild life. The efforts of each in its own field are encouraged by the Biological Survey, since it is recognized that forward movements, whether by large or small units, are nearer approaches to the coordinated nation-wide policy that is desired by all who have the interests of wild life at heart and the same ends in view.

The agencies designated by State law as defenders of wild life, supported by such organizations, prescribe the manner in which those birds and animals shall be protected, utilized, or controlled. The States are primarily responsible for those forms, including fur animals, that make the year-round stay in the same locality, and enact laws for their protection. Many States have extensive wild-life sanctuaries, and a number have established experiment stations for the propagation of game birds.

Federal agencies serving as wild-life defenders operate in much the same manner as do State agencies, and in cooperation with them, but obviously

[1] This report covers parts of two administrations of the Bureau of Biological Survey. On May 9, 1927, E. W. Nelson, who had directed the work for more than 10 years, was relieved of administrative responsibilities in order that he might complete important scientific studies and reports of explorations on which he had been previously engaged.

over a much broader field, since they have as their peculiar wards the forms that migrate between the States and across international boundaries, particularly the valuable wild fowl and the birds that prey upon the insect pests of the farmers' crops. The Biological Survey is directly accountable for the protection of migratory birds and for the administration of wild life on the Federal reservations under its jurisdiction. This function includes regulatory, policing, and control activities. When called upon, it also serves as counselor for other Federal agencies, State governments, and conservation organizations on matters pertaining to wild-life administration.

The program of the bureau includes wild-life research and administration, with reasonable control and regulation where necessary. In control and regulation, whenever uncertainty exists it is the policy to give wild life the benefit of the doubt. The bureau is able to assist materially in coordinating wild-life plans, by reason of the storehouse of information that it has built up and to which it is continually adding through field and laboratory investigations of the life histories, characteristics, and needs of the many forms of our native fauna. It is only by such coordination and by concerted action that the various groups of wild-life defenders will be able to attain their common objective. As a public-service institution, the Bureau of Biological Survey seeks to be a good neighbor not only to other Federal agencies and to States that are working for the same ends but also to the people of sections within the natural habitat of our valuable and interesting forms of wild life.

THE COMMON OBJECTIVE

There is no sharp line of demarcation between the activities of the three groups of wild-life defenders, as a spirit of partnership in a common cause is very generally apparent, each recognizing that its own plans are best forwarded by the constructive accomplishments of the others, and that no program of wild-life administration proposed by one can be carried out successfully without the generous cooperation of the other two.

Any effective administrative plan for handling the wild-life resources of the country, no matter by whom recommended or how well supported, must be worked out and applied while there remain not only sufficient representatives of the various species that are to be perpetuated but also areas of adequate size and character to support them in reasonable numbers. And in all cases it must be determined what is meant by "reasonable numbers," for wild-life guardians must frequently face the disagreeable fact that where nature does not curb undue increases of her creatures, the hand of man must do so.

From an economic viewpoint most birds and mammals become either beneficial to humankind or harmful to man and his works. There are renegades among animals and birds as well as among men. Control measures are especially necessary when the food supply on the available areas will support useful and harmless animals and birds in only limited numbers, or when predatory or otherwise injurious forms interfere with the operations of man or threaten the continued existence of more desirable forms of wild life on the suitable areas still remaining for their occupancy.

RESEARCH FUNDAMENTAL TO ADMINISTRATION

The cause of the wild birds and mammals can not be properly defended without a knowledge of their habits and life histories and of what the States and other units are doing for their perpetuation. Intensive research, such as has been undertaken for more than four decades by the bureau, is fundamental to administration and should be continued by careful experimentation.

Not only must surveys and counts be undertaken in places where wild life is now found, but other areas apparently favorable for supporting game and other animals must be studied. Basic facts regarding wild life must be disseminated for use by educational institutions and conservation agencies as well as by those engaged in the control of harmful animals. Research studies will develop an effective administrative plan for each type of game or other species of bird or mammal, in building up impoverished stock to optimum numbers, in curbing undue increase, and in controlling objectionable forms when this is necessary.

Experiment stations have been the cheapest and most effective means of determining the best crop-production methods in agriculture, horticulture, and forestry, and the results in these fields point to success in like methods of research in wild-life administration.

Already four field stations have been established by the Bureau of Biological Survey—a fur-animal experiment station in Saratoga County, N. Y., a station for cooperative quail investigations in southern Georgia and Florida, a reindeer experiment station near Fairbanks, Alaska, and an eradication-methods laboratory in connection with pest control at Denver, Colo. At the close of the year plans were practically completed for operating an experiment station in California to study the problems confronting the rabbit-growing industry. Through the cooperation of the Forest Service, field biologists also have made quantitative studies of the effects of rodents on forage production and reforestation.

The chief problem of the bureau is to obtain facts on which to base plans for wild-life administration. Until it has the necessary resources to gather these facts its work can not progress to that point where it can be of maximum benefit to the birds and game and fur animals of the country, or of greatest assistance to the general public or to governmental agencies having jurisdiction over areas essential to the maintenance of wild life, or that are confronted with the problem of controlling excessive numbers of either harmful or beneficial forms.

An increased series of refuges for birds and of preserves for big-game and other mammals will become invaluable field experiment stations for studying the needs of our birds and mammals, including habitat, food, and cover. These can furnish basic information for the efficient administration of such mammals and birds as may be maintained on Federal or State refuges, parks, or forests, or elsewhere. Opportunity to pursue research studies on refuges would unquestionably solve many perplexing problems of effective wild-life administration.

There is a close relationship in these field studies of wild life between field men of the survey and foresters and naturalists of the States and of the Federal Forest Service and the National Park Service. Field biologists can be assigned to parks and forests when studying the forms of life that make these places their natural habitat. The opportunity to use these natural outdoor laboratories as experiment stations is not being overlooked pending the time when it may become possible to increase the number of Federal wild-life experiment stations. Without a knowledge of the facts, there can be neither efficient administration nor intelligent regulation of wild life. The bureau desires exceedingly to meet its public obligations in wild-life administration. Its research activities are coordinated with a view to furthering the work of its whole organization, and its program has been carried out during the past year so far as its resources have permitted.

WILD-LIFE RESEARCH

GAME BIRDS

To maintain the nation's game birds in the face of an ever-increasing army of hunters and of a constant extension of industrial operations is a difficult undertaking. It has already engaged the earnest attention of game administrators, and progress has been made along several contributory lines, but not enough has been done to place the movement on a firm basis. Space in which the birds may live must be assured, their food supply safeguarded and increased, sufficient refuges established, propagation measures utilized, and adequate protection afforded.

FOOD RESOURCES OF WILD FOWL

Under a nation-wide survey of the food resources of wild fowl, started by the bureau some years ago, work has already been completed in Montana, North Dakota, Missouri, and northern Michigan, and in the sandhill region of Nebraska, and on this last-named area a report has been published. Another season's field work will practically finish the work in Minnesota.

Material progress was made on a survey of the aquatic plant resources of the Upper Mississippi River Wild Life and Fish Refuge in the summer of 1926, and work for the following year was started in June, 1927, with the expectation that a good general idea of the duck foods of this refuge will be gained before the close of the season.

In the past fiscal year study also was made of the wild-fowl food plants of a portion of the Okefinokee Swamp, in Georgia, and a brief inspection was made of conditions affecting the growth of aquatic plants in the Currituck Sound section of Virginia and North Carolina. Looking to the future of this project, a line of work that has been carried on since 1905, it will probably be essential to establish one or more experiment stations for the study of factors affecting the growth and general welfare of the plants upon

which wild fowl feed. When funds permit, the actual planting of waters on Federal reservations to improve them as feeding places for birds would be desirable.

UNWISE MARSHLAND DRAINAGE OPPOSED

Special efforts have been continued with a view to emphasizing the need of considering contemplated drainage projects, in order to prevent needless destruction of breeding, feeding, and resting places for wild life. Drainage and the reduction of water areas, coupled with disease among the waterfowl of the West, have had a disastrous effect upon these birds. Plans to afford relief for the bad situation in the Bear River marshes, Utah, unfortunately failed of consummation in the last Congress.

MIGRATORY BIRD REFUGES

By treaty with Great Britain the United States is pledged to give adequate protection to the useful species of birds that migrate between the United States and Canada. Much has been accomplished toward this through the application of principles developed through study of the needs of the birds, but the results thus far concern chiefly length of hunting seasons, bag limits, and methods of capture, all relating to the fall game harvest. Not enough has been done, however, to insure the perpetuation of breeding stocks through providing them requisite nesting, feeding, and resting areas. Canada is fulfilling her obligations under the treaty by the creation of a comprehensive system of refuges for wild fowl, while this country is lagging behind, though an international resource is endangered.

A measure has been pending in Congress for several sessions, under the terms of which a system of refuges would be provided at important concentration points of wild fowl in this country. This measure has failed of enactment partly through the fact that various interested agencies were not in agreement on some of its provisions. Practically all elements of the country now appear to be united behind the demand that the Federal Government shall do its share in the establishment of refuges for migratory birds.

Without resting, feeding, and nesting places for the birds, legal restrictions on killing will ultimately be of little avail. If these facilities are provided, however, it may even be possible in future years to lessen stringent regulations that for the present are essential to the very existence of our birds. The provision of migratory-bird refuges, with sufficient flexibility for adequate administration, would work mightily toward the salvation of the wild fowl of North America.

WATERFOWL CENSUS PLANS

To aid in the administration of the migratory bird treaty act and its regulations, plans were matured near the close of the fiscal year for obtaining more definite information regarding the numbers, distribution, and migrations of waterfowl in the United States, Alaska, Canada, and Mexico. The matter was discussed with representatives of many cooperative agencies, who seemed very favorable to the idea, and it was decided to undertake a series of monthly censuses so far as practicable throughout the continent. In working out the details a most generous response was received from State game departments and from many Federal agencies, including the National Park Service, the Bureau of Reclamation, the Office of Indian Affairs, and the Bureau of Education, of the Department of the Interior; the Bureau of Fisheries and the Bureau of Lighthouses, of the Department of Commerce; the Coast Guard, of the Treasury Department; and the Weather Bureau, the Forest Service, and the Extension Service, of the Department of Agriculture; as well as from the Izaak Walton League of America, the American Game Protective Association, the National Association of Audubon Societies, and many other organizations and individuals interested in the welfare of North American wild fowl. This is an interesting example of cooperation in scientific investigations undertaken under governmental leadership.

The work is being directed by the Survey with no increase of personnel or of funds, so that the voluntary services of interested observers must be largely depended upon to carry the project forward. Although this is crowding the general program in biological investigations, the need for the information sought is so great that it is deemed advisable to go ahead even at the sacrifice of other important work. Every effort is being made to establish this on a stable basis until resources can be provided to allow for the prosecution of the work on a more adequate scale.

Voluntary observation stations are being established where waterfowl concentrate for breeding, feeding, or resting. Instructions have been sent to all cooperators, and special dates set for each monthly census. All cooperators will make a simultaneous count of the waterfowl present in the locality assigned to them. This project will be a continuing one. Its expected result will be the establishment of comparative figures on increase or scarcity of birds in the various regions, to serve as a basis for future safeguarding measures.

WILD FOWL IN WESTERN STATES

Realizing the need for taking immediate steps to improve marshlands in the Western States, some of which, because of a scarcity of fresh water, have become death traps to large numbers of ducks, geese, and other birds, western sportsmen have raised a fund and have made it available to the department for conducting necessary surveys and studies. This fund totaled $5,684.85 on June 30, and will be increased during the next year. It has already enabled the Bureau of Biological Survey to enter into cooperative arrangements with the Bureau of Public Roads whereby engineering studies will be made at the Bear River marshes in Utah, at Malheur Lake in Oregon, and at Lower Klamath Lake in northern California and southern Oregon. The need of dike construction has been urged in the interest of the birds in these localities. As a result of the surveys conducted, not only engineering details but other pertinent information will be made available on which to base constructive legislation or other action required.

The movement, which started in California and has extended to other Western States, typifies the more enlightened attitude of sportsmen toward the needs of game, and with such cooperation some of the problems confronting the bureau will be readily solved.

The great mortality among wild fowl in Western States is to receive renewed and intensified study during the summer of 1927. Although alkali poisoning has been found to be the cause of mortality at Great Salt Lake, Utah, there is the possibility that elsewhere in the area mentioned other factors may be involved.

PROPAGATION OF GAME BIRDS

Game farms in Ohio and Ontario were visited during the year, and a Farmers' Bulletin on propagation of game birds, covering both aquatic and upland game, was published. Investigations also were made by a biologist of the status of the propagation in various European countries of North American and other migratory waterfowl, with particular reference to the relative adaptability of the different species to propagation. These resulted in the collection of data that will have a bearing on the issuance of propagating permits in this country, and also upon decisions as to suitable seasons and bag limits.

INVESTIGATIONS OF INTRODUCED BIRDS

Cooperative experiments have been conducted for several years in acclimatizing tropical game birds, as mentioned in former annual reports. These birds include the chachalacas, curassows, ocellated turkeys, and tinamous, introduced on Sapelo Island, Ga. The chachalacas have spread to the closely adjoining Blackbeard Island, a Federal bird reservation, where they appear to be well established and increasing. A few adult curassows brought in are thriving, but have as yet produced no young. Experiments with the other birds introduced have been less favorable.

The Biological Survey has on hand an extensive manuscript covering the history of introduced and transplanted birds in the United States, and a brief one on game birds suitable for introduction, which it hopes to publish soon.

Establishment of an experiment and introduction station is vitally necessary to solve problems of game-bird introduction, and when funds permit to carry out to the full the terms of the Lacey Act that provide for "the preservation, distribution, introduction, and restoration of game birds and other wild animals."

COOPERATIVE QUAIL INVESTIGATIONS

The quail investigation in southern Georgia and northern Florida, which is being conducted by the biological survey in cooperation with a committee of sportsmen for the purpose of learning the best methods of maintaining the abundance of these birds, is now in its fourth year and satisfactory progress has been reported. Methods

recommended for quail preserves include the raising of suitable quail-food plants, the control of fire, and the suppression of predatory birds, mammals, and reptiles. Adverse conditions have been experienced during the year, including more than ordinary drought, heat-addling of eggs, and consumption by ants of hatching birds. On the other hand, the breeding season was favorable on the whole, and the local supply of quail was increased partly by the application of the findings of the investigators and partly through increased importations of quail from Mexico.

Inspections were made of preserves in adjacent States, and correspondence conducted with preserve owners at greater distances, as a corollary to the studies at the headquarters of the investigation. Cooperation has been given by the Bureaus of Animal Industry and Entomology in studying diseased and parasitized specimens and by the Bureau of Plant Industry in germination studies of various quail-food plantings. Additional study material was obtained in the form of stomachs of quail, the contents of which were analyzed, and the banding of propagated, trapped, and introduced birds was continued and data on returns from previous bandings assembled.

The information obtained has been made available to preserve owners and sportsmen generally through the publication and wide distribution during the year of an extensive progress report.

BIG-GAME INVESTIGATIONS

In accordance with a resolution adopted by the American National Livestock Association at its last annual meeting and with the recommendations of the commission on the conservation of the Jackson Hole elk, the members of which were appointed by the chairman of the President's committee on outdoor recreation, plans have been completed for making comprehensive studies of big-game animals, the first of which will be concerned with elk in Wyoming. The purpose is to obtain essential information for the management and protection of big game under wild conditions in forests, on the open range, and on reservations. Studies will be made of factors that govern their distribution and migrations, as well as their food and its availability and of the cause of fluctuations in the numbers of the animals and their relation to livestock production and other interests of the communities.

BIG GAME ON FORESTS AND PARKS

Investigations of conditions affecting big game on national forests have been continued on a limited scale. A brief study of the elk peculiar to the Olympic National Forest in the State of Washington indicated that although there has been no legal killing of these animals for 20 years their increase is very slow and unsatisfactory, but the causes remain to be determined.

The mule deer of the Kaibab Plateau in Arizona present a problem that has been studied in cooperation with the Forest Service and the National Park Service since 1922. Summer and winter examinations show that although numbers of the deer have died of starvation, many of those seen being much emaciated, there are still more animals than the available forage will properly support, and both deer and forage on much of the area were found in deplorable condition. Legal complications affecting jurisdiction over the deer have tended to prevent the taking of effective relief measures, but it is hoped that conditions will be improved under a recent Federal court decision by which the authority of the Forest Service is recognized to kill deer when necessary to protect the forest.

The Kaibab deer problem is an outstanding example of the vital need for restricting big game to numbers proportionate to the food supply. Where, as on the Kaibab Plateau, this has not been done, the forage plants are killed or severely injured, and a correspondingly smaller number of animals can be maintained permanently. On the Kaibab area the destruction of forage on a large scale has resulted, the deer in their extremity at certain seasons even browsing and killing the young yellow pine and other forest trees. The forest reproduction is thus wiped out and the deer are subjected to untold misery. The fact that sufficient suitable range and forage, summer and winter, is of vital importance to big game is brought to attention in an impressive way by the Kaibab deer situation. The seeming paradox that in some areas game may have overprotection is also emphasized.

RESTOCKING EXPERIMENTS

Reservations of this and other governmental agencies serve to maintain

various wild animals that have been reduced greatly in numbers or threatened with extermination. When there are surplus numbers to be disposed of, these reservations serve as reservoirs for restocking other suitable areas. Surplus buffalo and elk have been disposed of in this way for several years. The increase to 67 of the 12 mountain sheep, placed on the National Bison Range, Mont., in 1922, furnishes a striking example of what may be expected where these splendid game animals are accorded proper protection. Some of these will be moved to other reservations, and within a few years a considerable surplus should be available for restocking many rugged areas from which mountain sheep have long since disappeared.

Experiments in the propagation of antelope are in progress. On the Wind Cave Game Preserve these attractive big-game animals are increasing. Seven fawns captured in the spring of 1927, through cooperation with the State game department of South Dakota, are thriving at Sullys Hill National Game Preserve, N. Dak.

In administering big-game reservations there is in many places the serious problem of the coyote to contend with. Where there are breeding places of these and other predatory animals in the vicinity, valuable game is menaced constantly. Occasional inroads of predatory animals within reservations of the Biological Survey have demonstrated how essential it is that these destroyers be eradicated where game is to be protected. The failure of game to increase or even to maintain itself in satisfactory numbers may in many places be directly traceable to the presence of predatory animals, and this emphasizes the necessity for control measures.

With funds contributed by E. E. Brownell and the Permanent Wild Life Protection Fund, the bureau has been enabled to make experimental introduction of antelope on the broad terraces bordering the inner gorge in Grand Canyon, Ariz., and the results are being followed with interest. Eleven young antelope were placed there in 1924. There have been some losses from various causes. The antelope are now divided into two little groups, one of nine animals near Hermit Creek camp and the other of five at the Indian Gardens. Four of these are young born last spring. It is believed that there is sufficient forage for several small bands of antelope and that these will thrive and constitute a notable attraction for the large numbers of visitors to the Grand Canyon.

The Arizona State game department, after consultation with the Forest Service and the Bureau of Biological Survey, placed 23 elk on the Blue Range State Game Refuge, in the Apache National Forest in March. The refuge is in high mountain country formerly inhabited by native elk that became extinct in 1898.

Preliminary steps have been taken to stock the Upper Mississippi River Wild Life and Fish Refuge with game and fur animals. One hundred and forty-two ducks of three species and two pairs of Canada geese also have been obtained and placed on Lake Winona, where they will be cared for by the city of Winona, with the expectation that they will not only attract many other wild fowl to this lake during migration but will serve also as a brood flock.

BIOLOGICAL SURVEYS AND LIFE-HISTORY STUDIES

STATE SURVEYS

Biological surveys made during the year have produced information essential to the completion of final reports on some of the State and other major units. These, together with studies of the life histories of our native fauna, are designed to provide basic scientific data regarding wild birds and mammals and the natural life zones of the continent. Investigations of the natural distribution of these forms are coupled with related studies of the distribution of native plant life.

Reports on this phase of biological research during the year included one on the mammals of Mount Rainier National Park prepared by a field naturalist of the Bureau of Biological Survey in cooperation with a former zoologist of the State College of Washington, and published by the National Park Service; and one number (No. 49) of the North American fauna series of the Biological Survey, on the mammals and life zones of North Dakota. Reports on the mammals and life zones of Oregon and on the birds of Washington are nearing completion, a report on the birds of Florida is well under way, and a manuscript on the birds of New Mexico is being revised for publication under State auspices. Progress has also been made toward the completion of a biological survey of Wisconsin.

Limited work was done on the habits, numbers, and ranges of game

birds and big-game animals in Alaska, continuing biological investigations that have for several years been in progress in the Aleutian Islands Bird Reservation and other parts of the Territory. Progress was made toward the publication of a booklet in the nature of a wild-life guide to southern Alaska, to acquaint travelers and others with the wealth of the wild-life resources of the Territory.

IDENTIFICATIONS AND TAXONOMIC WORK

Arrangements are made for accurate identification of species involved in wild-life investigations or of interest to correspondents. Data from field reports and from published literature regarding the occurrence, habits, and distribution of birds, mammals, reptiles, and amphibians are assembled in card-index files, on maps, and in other convenient form. As a result the bureau acts as a clearing-house of information for the benefit of administrators, educators, and writers in this country and abroad.

A report in the North American fauna series (No. 48) on the genus Phenacomys, a group of voles, was published, and at the end of the year a similar report on lemmings of the genus Synaptomys was in press (No. 50 of the same series).

MIGRATORY AND OTHER HABITS OF BIRDS

Progress has been made during the year in determining the movements of migratory birds and the general distribution and breeding habits of species occurring in the United States, through field studies by representatives of the survey and by extended cooperation enlisted throughout the United States, Canada, and Mexico from organizations and individuals interested in bird life. Reports as to the local occurrence and movements of birds coming from points throughout the entire country are particularly valuable as supplementing similar reports that have been submitted from many of the same localities over a long period of years.

Progress also was made in the censuses of nesting birds. This work was started in 1914 and is yielding useful information regarding the abundance of breeding birds on different types of land and the fluctuations in their numbers due to seasonal or other natural causes, or to changed environments or State laws. A circular (No. 261) on the purposes of bird censuses and how to take them was revised and issued during the year.

Bird banding.—There has been a steady increase in the number of bird-banding cooperators working under Federal and State permits, in the number of birds banded, and in the return records of birds banded during this and preceding years. There are now 1,296 bird-banding cooperators, including 91 in Canada. Most of the bird banding is done by volunteer cooperators, but some by representatives of the bureau, including work during the year in the Yukon Territory and adjacent parts of Alaska. A visit to the Bear River marshes in Utah, one of the most important concentration and breeding grounds of waterfowl in the country, resulted in banding about 1,000 ducks of several species, and important information has been obtained regarding the later travels to 13 States of ducks banded in this region.

The total number of birds reported as banded during the fiscal year was 91,848. This is an increase of 22,000 over the previous year and brings the total banded since 1920 to about 300,000. As the number of banded birds becomes greater, the number and significance of the returns are materially increased. Return records for the year numbered 4,445, an increase of 33 per cent over the previous year, and are concerned chiefly with game species. There is a marked increase, however, in the number of records of small nongame birds, species that are of great interest to agriculturists and the bird-loving public.

A technical bulletin entitled "Returns from Banded Birds, 1923–1926," containing more than 10,000 records received during that period, was completed for publication. Progress also has been made in the preparation of a manual for volunteer cooperators, giving working details of bird-banding methods, station operation, and devices employed.

FOOD HABITS RESEARCH

Laboratory examination was made during the year of 1,675 stomachs and 338 pellets of birds, the food found in a number of bird houses, 79 stomachs of mammals, and 194 of reptiles and amphibians. Of the birds' stomachs examined, those of red-winged blackbirds, ruffed grouse, and various fish-eating birds and shore birds predominated, and among the mammals examined were many seals from the west coast.

Examinations also were made of bird-stomach material submitted by institutions and persons interested in the food habits of birds in 13 States. More than 360 of the stomachs were of ruffed grouse, the Bureau of Biological Survey cooperating with the grouse investigation committee of the National Game Conference, which is studying the causes of decrease in the numbers of this bird. Many of the bird pellets examined were of marsh hawks, studied in their relation to quail in southern Georgia.

Maintaining and adding to the extensive files of information on the food of birds, mammals, reptiles, and amphibians and increasing the collections of insects, other invertebrates, skeletons, and seeds formed a regular feature of the food habits research.

ECONOMIC ORNITHOLOGY

LOCAL STUDIES OF INJURIOUS AND BENEFICIAL BIRDS

Blackbirds in Louisiana.—Examination of more than 1,300 stomachs of red-winged blackbirds and jackdaws collected in the rice-growing section of southwestern Louisiana is nearly finished. Information gained from this examination and field work carried out in 1925 and 1926 will furnish the subject matter of a detailed report on the economic relation of blackbirds to the rice crop in Louisiana, the manuscript of which is nearly complete. This study treats not only of the economic status of the birds involved but also of the feasibility of control measures in areas where damage is severe.

Bobolinks and blackbirds in North Carolina.—One of the few remaining rice fields in North Carolina was the scene of experimental work directed toward the reduction of the damage inflicted annually by migrating flocks of bobolinks and resident colonies of red-winged blackbirds. In this region bobolinks have long been a serious menace to the rice crop in the "milk" stage, necessitating the expensive and discouraging practice of bird minding. In the course of this work automatic firing devices that are at times useful in the protection of small areas were found ineffective. It was ascertained that the cost and labor of patrolling the fields with firearms could be lessened materially, however, by using a small-caliber rifle in place of the customary shotgun, and that large areas can be kept free of birds by firing from a single shooting stand. By this means the cost of ammunition was reduced to about a fifth and labor to about one-fourth. Both red-winged blackbirds and bobolinks respond more readily to the frightening effect of the rifle ball than to shot, and the work of bird minding is thus made easier.

Hawks and other so-called "vermin."—Depletion of upland game birds has directed the attention of sportsmen and conservationists to the factors that may have contributed to this reduction. Naturally birds of prey have been blamed, and campaigns for their destruction have been carried out in many localities. On the other hand, the value of these birds as destroyers of rodent and even insect pests long has been recognized, and on this ground their conservation is urged by many students of ornithology. Efforts are being made to obtain a large series of stomachs of the birds killed in vermin campaigns. These will be examined and used as the basis for a thorough study of the economic value, under present conditions, of hawks and owls.

BIRD ENEMIES OF INSECT PESTS

Increasing their numbers.—The cooperative study of the relation of birds to nut weevils, carried out in conjunction with the Bureau of Plant Industry, disclosed a readiness on the part of the birds to inhabit man-made nesting facilities, making possible a decided increase in their numbers in the experimental area. It is too soon, however, to note the effect of an increase in bird life on the prevalence of nut weevils. Revision of two Farmers' Bulletins on methods of attracting birds in different sections of the United States, containing lists of food plants for these sections, were issued during the year. Four available bulletins on this subject cover by sections the greater part of the United States.

Enemies of the celery-leaf tyer.—In the vicinity of Sanford, Fla., where about a third of the celery crop of this country is produced, the control of the leaf tyer is an outstanding problem. At the request of the State plant board an investigator was sent to Florida and spent a month in the infested section to determine the extent of the beneficial work of birds in the control of this pest. The results of the study showed that at least four species of birds, the palm warbler, the tree swallow, the red-winged blackbird, and the meadow lark, played an important part in the control of the leaf

tyer. Palm warblers frequently were found feeding on the larvæ, obtaining about three-fourths of their food from this source, and flocks of tree swallows habitually followed the dusting machines, capturing the adult moths driven out by the dust. As much as 98 per cent of the stomach contents of some of the tree swallows was composed of the moths.

RELATED WORK IN EUROPE

In the course of a mission to Europe a biologist of the survey established contacts with organizations supporting the study of economic ornithology in France, Belgium, Czechoslovakia, Hungary, and Great Britain. Methods were discussed and the basis laid for future cooperation that will be of value in the increasingly important international phases of bird protection. Toward the end of his trip he represented the department at the International Congress for the Study and Protection of Birds, held at Brussels, June 6–9.

ECONOMIC MAMMALOGY

Research work with useful mammals, with those that are injurious, and with those whose economic status is problematical, has been concerned primarily with investigations for the conservation of our valuable resources of fur, both in the wild and on fur farms, with improvements in Alaskan reindeer herds, and with experiments for the effective control of injurious rodents, predatory animals, and other forms that interfere with the success of agriculture, horticulture, forestry, stock raising, and game administration.

TRAPPING INVESTIGATIONS

The importance has been stressed during the year in correspondence, in addresses, and in the annual Farmers' Bulletin on the fur laws, of recognizing the needs of our fur-bearing animals if they are to continue in existence in face of the constantly increasing demand for fur, and of curbing the overtrapping menace to the fur supply.

Overtrapping.—The responsibility of the individual States in fur administration is especially to be emphasized, for if they do not take the steps needed for the protection of their stocks of fur animals, the revenue from this source is sure to diminish and, of far greater import, many of the former suitable haunts of these valuable and interesting animals will know them no more. The main requisite is a recognition of the fact that trapping should be allowed only during the period of prime fur and should not include the breeding season. Ideal trapping seasons for various sections of the country are being investigated.

That natural resources in furs are steadily diminishing is shown by the fact that the raw-fur catch during the season 1925–26 was approximately 20 per cent less than that of the previous year, and the decrease for 1926–27 was still greater. If trappers continue to disregard fur laws and to trap out of season, more and more species will be reduced below the point where it is profitable to take them. The recent flood in the Mississippi Valley caused heavy losses of wild life and will result in a greatly reduced fur catch for the next season in the flooded area. The problem of conserving the remnant of the fur supply and of supplementing it from other sources becomes of vital importance to one of the oldest industries of the country.

The Biological Survey believes in the principle of conservation of fur animals and other valuable species through wise use, irrespective of the stand taken by those who consider the fur bearers only from the purely commercial viewpoint, or of those who consider many of them as "vermin" enemies of game, or of that group of individuals who have purely esthetic views. The merits of all these should be recognized by all wild-life administrators, but no one of the viewpoints can be emphasized at the expense of another without disrupting the "wise use" principle.

Educational work of the bureau was continued with a view to impressing these facts upon the minds of the youth. A booklet entitled "Our Furry Friends," designed to teach the value of fur as a natural resource, was distributed to school children in rural districts throughout the United States, jointly by the National Association of the Fur Industry and this department, through the Extension Service and the Bureau of Biological Survey. A set of lantern slides illustrating fur animals, accompanied by explanatory text, was prepared in cooperation with the Extension Service for use chiefly in classroom work. Articles on North American fur animals also have been prepared with the view of informing members of the fur trade regarding the requirements and life habits of these animals, as well as on the pro-

tection afforded fur bearers in the various States.

EXPERIMENTS IN THE PROPAGATION AND CONTROL OF WILD ANIMALS

Through a number of wild-life experiment stations, some of which are already established, it is planned to obtain the fundamental information constantly in demand from correspondents and others on the propagation and control of wild animals. Supplementary to the work at stations already in operation, studies are made of animals in their natural habitat and of practices on successful fur farms, including rabbitries, both directly and in cooperation with individuals and associations working for the solution of problems involved.

FUR-FARMING INVESTIGATIONS

Fur farming has continued to develop steadily in the United States and Alaska during the past year. The fox-farming business is now on a more stable financial basis than ever before, and as the market demand for silver-fox pelts of good quality has increased, the proportion of inferior skins has been greatly reduced. The inspection and registration of silver foxes, conducted by the American National Fox Breeders' Association, is in large measure responsible for the progress made in producing fur of better quality. Raw-fur men and the survey have helped in bringing about the change by continually stressing the need for such improvement.

Representatives of the bureau availed themselves of every opportunity to acquaint breeders with improved management practices in the breeding, feeding, and handling of silver foxes. The field work of inspecting fur farms and gathering information on the many problems confronting fur farmers has been continued. Improvements have been noted in methods of feeding and ranch sanitation.

Interest in muskrat and beaver farming is shown by the fact that many areas, particularly in those States bordering the Great Lakes, have been fenced and stocked with these fur animals. Breeding stock is bringing almost fabulous prices, and certain sections of the country are being closely trapped to obtain live animals. Whether or not muskrats and beavers can be raised profitably for fur in fenced inclosures is yet to be determined. The business is not without its propaganda, similar to that formerly used by large corporations in the early development of the silver-fox industry, and consequently there is exploitation—on the breeding stock rather than on the pelt basis.

A leaflet on mink raising, shortly to be published, was prepared during the year for distribution to those interested.

FUR-ANIMAL EXPERIMENT STATION

On the fur-animal experiment station maintained by the bureau in the foothills of the Adirondack Mountains, Saratoga County, N. Y., studies are progressing of the most satisfactory methods of raising fur animals in captivity. The need for further research work in the cause and control of epizootic diseases has been increasingly evident, for the department should be in position to advise fur farmers on the control of disastrous outbreaks. Epizootics among foxes show that there are apparently a number of different diseases involved, and these findings are confirmed by other investigators in similar fields. Very little, therefore, can be accomplished in controlling outbreaks before the real cause of the trouble is known, and these causes can be determined only in the laboratory.

Continued studies at the experiment station have demonstrated that foxes with inferior pelts, even though mated with foxes of superior fur, continue to produce inferior offspring. Unsuitable foods and feeding methods, as well as parasitic infestation, are contributory factors in producing inferior pelts. Investigations of parasitic diseases and their treatment have been in progress, and in this work the Bureau of Animal Industry has cooperated by laboratory examinations of diseased organs and inspection of live animals on the farm. A report entitled "Critical Tests of Tetrachlorethylene as an Anthelmintic for Foxes" was published in the Journal of Agricultural Research during the year.

Large exercising pens have proved to be a useful addition to the station. Foxes kept in these inclosures develop well and fur out better than those kept constantly in breeding pens. More feed is consumed in the larger pens, but the lessened labor and time involved in caring for foxes offset the additional feed costs.

The benefits derived from this work do not end with the actual raising of

animals in pens. The data obtained will aid also in furnishing necessary information for the formulation of uniform trapping laws, through determining breeding and prime-fur periods, and thus form a basis for important conservation measures.

With the increased attention to fur farming in Europe, representatives of various countries have visited the fur-animal experiment station to note the conduct of the work and the results obtained. Exportations of fur animals from this country have continued during the past year, consisting chiefly of silver and blue foxes, martens, minks, and skunks. The French Association of Fur Animal Propagation has translated bulletins and leaflets of the department on fur animals and published a compilation under the title of "Methods d'Elevage des Animaux a Fourrure." Other bulletins on fur animals have been translated into German, Russian, and Norwegian.

BEAVER-TRANSPLANTING EXPERIMENTS

Progress has been made in studying the habits of beavers as a basis for preventing damage by these animals and providing for their conservation and increase in localities where their presence is desirable, and where they may be a financial or recreational asset.

A bulletin to supersede Department Bulletin No. 1078, Beaver Habits, Beaver Control, and Possibilities in Beaver Farming, was completed and ready for the press at the close of the year. In Montana, North Dakota, Minnesota, Michigan, and Wisconsin, demonstrations of procedure in the trapping and transportation of live beavers were given to State game officials, landowners, and others.

A field naturalist of the bureau has further improved a trap for taking beavers alive, a description of which was published in a revised circular (No. 69-M) of the department. This is designed for beavers only, and is now being used by State conservation departments and other agencies for removing these animals from areas where they are not wanted and planting them in localities where they are desired, either for propagation for their fur or as added attractions in parks.

RABBIT EXPERIMENT STATION PLANNED

The rabbitry at the fur-animal experiment station in New York is gradually developing and valuable information is being obtained. Breeders have realized, however, the need for expanding the experimental work, and have offered several sites in California on which to establish a station for this purpose. At the close of the year negotiations were practically completed for the acceptance of 5 acres of land and a fully equipped experiment station at Fontana, Calif., offered by the National Rabbit Federation and the Fontana Farms Co.

Studies have been made of conditions in rabbitries, especially methods of feeding, breeding, and housing. Various kinds of houses, hutches, and nest boxes have been constructed at the Saratoga station to ascertain which types are best suited to the production of domestic rabbits, and drawings have been prepared and blue prints made for free distribution through the cooperation of the Bureau of Public Roads. A leaflet (No. 4) entitled "Raising Domestic Rabbits" was published for the benefit of those desiring the information in concise form.

Domestic rabbit pelts of good quality are in demand and less than 2 per cent of the total number required in the fur trade are produced in the United States. Farmers' Bulletin No. 1519, Rabbit Skins for Fur, was published for the information of breeders regarding methods of handling rabbit skins from the time the pelt is removed until it reaches the raw-fur market.

In producing rabbits for meat and fur there are waste materials that are capable of utilization. A cooperative investigation with the Bureau of Soils developed that part of the waste is recoverable as valuable by-products, including grease, dried blood, and fertilizer.

REINDEER EXPERIMENT STATION

Improved practices in reindeer production and herd management are vital to developing the resources of Alaska. In this connection, therefore, the establishment of the reindeer experiment station at the Agricultural College, Fairbanks, Alaska, and inauguration there of grazing investigations are noteworthy accomplishments.

A number of reindeer and additional caribou have been obtained for use at the reindeer experiment station, where feeding experiments will be continued and efforts made to determine the practicability of crossbreeding to de-

velop animals larger and better adapted to grazing conditions in Alaska. By Executive order, a section of land was added to the station during the year.

The present grazing investigations are designed to utilize better one of the natural resources of Alaska. The studies, while primarily concerned with reindeer production, will serve also to show the possibilities of general forage resources. This work has a direct bearing on grazing and farming development, through determining what animals are adapted for use under Alaskan conditions, and the relationship that reindeer may sustain to the production of other types of domestic livestock. Experimental studies have been carried on to determine the forage value of lichens, shrubs, sedges, and other plants and the extent to which reindeer may utilize them most profitably, and to test possibilities in using grain and hay as supplemental feed.

Important methods of handling reindeer on the range have been developed, including the use of corrals and practical systems of marking for ownership and distributing equitably the increase of community herds, and effort has been made to assist all who are engaged in raising reindeer in Alaska in management practices. Department Bulletin No. 1423, Reindeer Grazing Investigations in Alaska, and a mimeographed leaflet (Bi–905), on Percentage Marking of Reindeer, were published during the year.

Following the passage of the new Alaska grazing law, and at the request of the governor, proposed regulations for the control of grazing were submitted to him. The interest of the Canadian Government in reindeer production has been evidenced by the detail of representatives to the reindeer experiment station during the year to obtain information that may be of use to the management of reindeer herds in the Dominion.

ERADICATION-METHODS LABORATORY

The eradication-methods laboratory maintained at Denver, Colo., continued investigational work for controlling injurious mammals by the development of improved poisoning methods. Strychnine and thallium compounds were studied, as were the results of experiments in utilizing different kinds of poisoned grain. The objective is to standardize poison mixtures and grains for the various species of rodents, in order to develop poison baits that will be effective and economical, and of practical use to the farmer and stockgrower.

RELATED CONTROL INVESTIGATIONS

The investigation of red squill as a rat poison, which has been conducted in Washington, D. C., as a cooperative project with the Bureau of Chemistry during the past three years, was brought to completion. As a result powdered red squill has been developed as an effective rat poison that practically eliminates danger to human beings and domestic animals. It is already being manufactured and sold on a large scale in the United States. Attention also has been given to methods of applying calcium-cyanide fumigant for the control of rodents under varying local conditions. Experiments with numerous repellent substances designed to protect trees and other plant life from the depredations of valuable fur-bearing and game animals have also been undertaken in eastern States during the year.

Comparative tests of commercial preparations and devices for the destruction of rodent pests are made as they appear on the market, in order that the bureau may learn the relative merits of all known control methods.

FIELD STUDIES OF RODENT AND OTHER PESTS

Detailed field studies have been made to determine the important relations that rodents and other small mammals bear to forestry, grazing, and agriculture. The relationships here are exceedingly intricate. Certain species are more or less destructive at practically all times; others that ordinarily are harmless or even beneficial may become destructive at certain seasons or under unusual conditions.

Results of field studies and check by the use of experimental plots have demonstrated that prairie dogs may not only destroy regularly 25 to 50 per cent of the pasturage on infested areas, and often more than 80 per cent of the grasses most palatable to livestock, but in times of drought may constitute the final critical factor in overgrazing, driving out livestock, and causing permanent damage to the range through the destruction of plants and the erosion following in its wake.

Field studies of the relation of rodents to forestry have been continued. Particular attention has been given to the life history of the porcu-

pine and the serious damage done to forest trees and nursery plantations, and much has been learned that will afford a practical basis for control measures where required. Strychnine and salt have been found effective in control operations, and field trials have been in progress during the year in Arizona, California, and Oregon. Damage by porcupines to gardens, field crops, and hay meadows, especially alfalfa and clover, was also disclosed. A report on the porcupine in relation to forest production is planned for publication.

Detailed studies regarding jack rabbits have been in progress also, and information has been accumulated regarding their destruction of range grasses. The damage becomes particularly evident during critical periods of drought, when the rabbits may destroy practically all available forage in their vicinity, and even sagebrush, cactus, and similar plants. Considerable additional information was obtained regarding damage by snowshoe and cottontail rabbits to natural seeding and plantings in forests, and to orchard trees. Attention also has been given to the rôle of ground squirrels, chipmunks, tree squirrels, pocket gophers, kangaroo rats, wood rats, and various species of meadow mice in relation to crops, forage grasses, forestry, and horticulture.

Representatives of the survey joined with other Federal, State, and private agencies in studying the striking increase and migration of house mice and meadow mice that occurred in the vicinity of Buena Vista Lake, in Kern County, Calif. Information was obtained regarding the character and extent of damage done, the enormous numbers of mice involved, and factors such as favorable weather, feeding, and breeding conditions, which made possible such remarkable multiplication. Effective control measures were determined for application on a large scale in cooperation with State and local agencies. Diseases prevalent among the mice, which also destroyed them in limited numbers, were studied in cooperation with representatives of the United States Public Health Service and the Rockefeller Institute for Medical Research.

Special study has been made in Washington and Oregon of the relation of pocket gophers, mice, and moles to bulb production, a rapidly growing industry on the Pacific coast. Much has been learned of the destructive habits of these animals and the conditions under which damage by them is most likely to occur, including information that may be useful in control measures.

Careful consideration is being given to the relation of native animals to new, as well as established, lines of crop production. In cooperation with the United States Public Health Service and with State and local agencies, studies have been made also of the intricate relation that rodents may sustain to the health of man and domestic animals, through their serving as carriers of diseases and parasites, as in the case of spotted fever, bubonic plague, tularemia, and septicemia.

REPTILES AND AMPHIBIANS

A report on the habits and economic relations of the alligator, largest of our reptiles, was completed during the year, and revisions were made of two mimeographed circulars dealing with snakes. Studies of reptiles and amphibians continue to develop sound reasons for change in the traditional hostile attitude of the public toward these animals, and educational work intended to ameliorate the situation is carried on whenever practicable.

MAINTENANCE OF WILD LIFE ON RESERVATIONS

With the settlement of the country, involving the removal of forests, the drainage of marshes and water areas for cultivation, the building of towns, and the construction of roads, together with excessive killing by hunters and inroads by predatory animals, the game and other useful wild life early disappeared from many sections. Public opinion is now, however, becoming aroused to an appreciation of the economic, recreational, and educational values of the presence in reasonable numbers of many forms of wild life. This has given a real impetus to conservation, and experience in wild-life administration has demonstrated the practicability not only of saving the remnants of our animals and birds but through restocking measures to restore them to territory long depleted. A commendable zeal to conserve game and other forms of wild life has in a few places even resulted in a surplus. Game-administration programs should, therefore, provide for the maintenance of a suitable number of breeding individuals and the utilization, ordinarily through hunting, of any surplus that may accrue.

Increased population and the more intensive uses of land have led to the establishment of a number of big-game preserves and bird refuges throughout the United States and its possessions, where many species of mammals and birds, particularly those that have been greatly reduced in numbers or are threatened with extermination, are afforded special protection.

The rapidly developing interest in the preservation of wild life in its native haunts is taxing to the utmost the very limited resources of the bureau to maintain even without material improvement the 76 areas already placed under its care, and to examine and prepare to maintain additional areas being proposed for reservations. Many of these reservations, particularly some on inaccessible islands, are rarely if ever inspected and some exist only on paper. Without resources to investigate their present suitability for the purposes for which reserved, very few measures can be taken for their development. No protection can be afforded in some cases except such as may be given locally by sympathetic individuals.

Reservation administration covers as far as possible activities under four divisions: (1) Protection and maintenance of bird refuges and game preserves; (2) acquisition of lands for wild-life reservations; (3) restocking reservations; and (4) examinations and surveys to ascertain the suitability of areas proposed for reservations. A list of wild-life reservations now under the jurisdiction of the Bureau of Biological Survey and of bird refuges and game preserves incidentally maintained by other branches of the Federal Government was published in the Yearbook of Agriculture for 1926, showing for each the chief species of animals and birds protected.

The reservations under the jurisdiction of the Biological Survey include four fenced areas primarily used for buffalo, mountain sheep, antelope, and other big game; a winter elk refuge in Wyoming; the Upper Mississippi River Wild Life and Fish Refuge; the Curry Game, Bird, and Fish Refuge, Alaska; the Alaska Railroad Muskrat and Beaver Refuge, Alaska; and 68 other areas in the United States, Porto Rico, Hawaii, and Alaska that are primarily bird refuges. Some of these widely scattered bird refuges are notable island colonies, containing interesting species not found elsewhere, and the need of extending them special protection to prevent extermination is vital.

BIG-GAME PRESERVES

The approximate number (count of young incomplete) of big-game animals on fenced areas of the Biological Survey on June 30 is shown in Table 1.

Seven of the antelope at Sullys Hill were fawns captured in western South Dakota and transported to the preserve for artificial rearing in June. These are doing well and should become the nucleus of a valuable herd. There are also 16 tame Canada geese and 55 mallard ducks on this area.

At the National Bison Range a number of mallard ducks nested along Mission Creek, and sharp-tailed grouse and ring-necked pheasants were noticeably more numerous inside than outside the reservation limits.

On the Niobrara Reservation a few wild turkeys introduced in 1925 produced several broods of young, and it is estimated that there were about 100 each of sharp-tailed grouse, prairie chickens, and bobwhites.

The normal increase of big-game animals, especially on the National

TABLE 1.—*Big-game animals on reservations of the Bureau of Biological Survey, June 30, 1927*

Area	Buffalo	Elk	Antelope	Mountain sheep	Deer		Total
					White-tailed	Mule	
National Bison Range, Mont.	625	[1] 308	----	67	[1] 37	[1] 149	1,186
Wind Cave Preserve, S. Dak.	158	[1] 143	22	----	----	----	323
Sullys Hill Preserve, N. Dak.	16	[1] 35	9	----	1	----	61
Niobrara Reservation, Nebr.	80	[1] 100	10	----	1	----	191
Total	879	[1] 586	41	67	[1] 39	[1] 149	1,761

[1] Estimated.

Bison Range and the Wind Cave Game Preserve, is enlarging the herds beyond the carrying capacity of the range. This has necessitated disposing of 61 buffalo and 29 elk during the year, and larger numbers must be removed in the near future.

WINTER ELK REFUGE

The vital importance of the elk refuge, near Jackson, Wyo., to the Jackson Hole elk herd for winter feeding was again demonstrated. A few elk began to enter the refuge as early as October 30, the confidence shown by these wild animals indicating in a gratifying way their knowledge and appreciation of this haven. The winter season was one of unusual severity, but fortunately the previous mild winter, during which no feeding was necessary, permitted the accumulation of a large stock of hay. Without this accumulation there would have been a serious shortage. Part of the hay was purchased by the State of Wyoming and part raised on lands of the Elk Refuge and on lands purchased by the Izaak Walton League of America. Regular feeding became necessary on January 20, two days after a heavy snowfall, and because of the great depth and slow melting of the snow in the mountains adjoining the refuge, feeding was continued until April 27, the latest date thus far recorded on the refuge.

The average number of elk fed daily during the winter was estimated at 6,625, but a careful count in March revealed the presence of 7,549 on the feeding grounds. Some losses were recorded of calves and of animals that had probably entered the refuge in weakened condition.

The lands purchased by the Izaak Walton League were offered to the Government, and authority for their acceptance has been granted by Congress. Formal acceptance will be made as soon as legal steps in connection with transfer of title have been completed. The lands have been much needed as an addition to the refuge, and the action of the Izaak Walton League is a public-spirited conservation measure of far-reaching importance.

WYOMING ELK, A PROBLEM IN GAME ADMINISTRATION

The elk commission, members of which were designated by the chairman of the President's committee on outdoor recreation, and consisted of representatives of Federal and State Governments and important organizations interested in the protection of wild life, met in Washington, February 28 to March 3, and gave thorough consideration to problems relating to the elk herds. The sense of the commission's findings, recently published, was that provision should be made to care for an optimum number of 20,000 elk in the so-called Jackson Hole, or southern Yellowstone, herd.

The maintenance of such a herd will necessitate the acquisition of additional land in the winter-refuge section to insure adequate winter feeding facilities. The recommendation of the commission also urged the disposal of any surplus in order to prevent a recurrence of deplorable starvation conditions, which at intervals in the past have made heavy inroads on the herd.

In accordance with one of the recommendations of the commission, plans were made to assign an experienced biologist to a study of the life history of the elk. A count made early in the year by representatives of the Forest Service, the Bureau of Biological Survey, and the State Game Commission of Wyoming, showed that the herd

TABLE 2.—*Hay available for the Jackson Hole elk and the quantity fed on the Winter Elk Refuge*

Source of supply	Area in hay, summer of 1926	On hand July 1, 1926	Produced or bought during the year	Total available for feeding, season 1926–27	Fed winter and spring of 1926–27	On hand June 30, 1927
	Acres	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Raised on Elk Refuge	625	1,453	835	[1] 2,268	1,326	942
Raised on Izaak Walton League lands	320	597	273	870	170	700
Purchased by State		1,370	1,684	3,054	[2] 1,510	[3] 300
Total	945	3,420	2,792	6,192	[2] 3,006	1,942

[1] Shrinkage due to deterioration.
[2] Part of the hay purchased by the State was fed to elk outside the refuge.
[3] Held on ranches in the vicinity of the refuge.

numbered 19,238, a total only slightly different from the figures of a similar count two years before. It is evident, therefore, that the optimum number has practically been reached and that the problem of the disposal of the normal increase must be squarely faced. How any surplus shall be disposed of is a matter that must be determined primarily by the State of Wyoming.

UPPER MISSISSIPPI RIVER WILD-LIFE AND FISH REFUGE

On the Upper Mississippi River Wild Life and Fish Refuge the acquisition of lands has been continued. The area thus far acquired from all sources, more than 60,000 acres, are now under administration, and measures are being taken to extend suitable protection to the wild life now found there and to increase the stock by introduction. The establishment of this refuge has made a strong appeal not only to the people in its immediate vicinity but to conservationists generally throughout the country.

Regulations for the administration of the refuge have recently been issued and their operation will tend to insure the safety of the wild life to be protected there, to prevent fires, and to provide for coordinating recreational uses.

OTHER IMPORTANT REFUGES FOR BIRDS

Lake Malheur Bird Reservation, near Voltage, in eastern Oregon, has enjoyed a more favorable spring and has better prospects than for several years. The unusual spring rainfall raised the water 2 feet above the level of last year, and with the continued flow of the Blitzen and Silvies Rivers there should be sufficient fresh water to prevent a recurrence of the extensive waterfowl mortality that has been so prevalent in recent years. The colonies of terns, herons, and cormorants are prospering, as well as those of ducks and geese.

Big Lake Bird Refuge, in northeastern Arkansas, suffered in some respects and was benefited in others by the spring floods of 1927. In spite of the floods, wood ducks have more than held their own, but a few wild turkeys and deer on the refuge were forced out by the high water and no trace of them has since been seen. The water stood 10 to 20 feet deep over the refuge area for more than two months and killed many small willows that had gained a foothold during dry seasons and were encroaching on desirable open water areas; however, it also killed much aquatic vegetation that later in the season would have furnished food for visiting wild fowl.

NEW AND ABANDONED RESERVATIONS

During the year Walker Lake Bird Refuge, in northeastern Arkansas, which had been rendered valueless by drainage operations in the vicinity, was abandoned.

Five new reservations were created by Executive order during the year, as follows: (1) The Columbia River Bird Refuge, on August 28, 1926, embracing two small islands in the Columbia River, near the mouth of the Walla Walla River, Wash., favorite resting places for geese and ducks. (2) Curry Bird, Game, and Fish Refuge, Alaska, on February 21, 1927, an area where all wild life is given full protection, except brown and grizzly bears, wolves, and wolverenes, which may be killed under certain restrictions. This is a tract of 14 square miles about the Government hotel at Curry, on the Alaska Railroad. (3) The Alaska Railroad Muskrat and Beaver Refuge, on February 21, 1927, consisting of eight tracts aggregating 6 square miles, along the railroad, on each of which trapping or otherwise killing beavers and muskrats is unlawful except under rules and regulations of the Secretary of Agriculture. Beavers have been active in building dams along the railroad, where owing to their accessibility they were an attraction to visitors and tourists, but also were a temptation to trappers, so that it seemed advisable to protect them and their breeding areas. (4) The Savannah River Bird Refuge, S. C., on April 6, 1927, an area primarily valuable for waterfowl in winter. (5) The McKay Creek Bird Refuge near Pendleton, Oreg., on June 7, 1927, an irrigation reservoir, primarily a resting place for ducks and geese.

RECREATIONAL USES OF WILD-LIFE RESERVATIONS

It is only on such reservations as the big-game preserves that the buffalo is to be found in its native haunts under almost pristine conditions, and there are few places in the country other than on national parks and similar reservations where the public can study and enjoy animal and bird life amid conditions comparatively un-

changed. Each year the public is availing itself more fully of the exceptional recreational opportunities afforded by the reservations, as shown by the increased numbers of visitors to some of the larger and better known ones. It is gratifying to note this public appreciation, though the presence of visitors often increases the burden on the available funds and personnel.

While created primarily for the protection of wild life, the Upper Mississippi River Wild Life and Fish Refuge will also lend itself to recreational uses on a large scale, including camping, fishing, and even public shooting on certain areas that will be opened to hunting under regulation. Public shooting of migrating game is permitted also on portions of several other reservations, and not only are the purposes for which the reservations were set aside not endangered thereby, but this use indicates that such tracts can produce annual harvests of aquatic wild life with both pleasure and profit to the public.

The Burtness Scenic Highway, which passes through about 2 miles of the Sullys Hill Game Preserve, near Devils Lake, N. Dak., was completed during the summer of 1926, and has more than doubled the number of visitors—during the year 21,313 persons and 4,590 automobiles were recorded at the preserve.

In order that the public may be fully informed regarding the attractions of the various reservations, and that nature lovers may obtain reliable and complete information, it is highly desirable that a biological reconnaissance be made of each reservation with the view to publishing fully descriptive bulletins on their more important features. Lack of funds, however, precludes this for the present.

URGENT NEEDS OF RESERVATIONS

Funds provided for warden service and for repairs and improvements have in recent years sufficed only for the most urgent needs in maintaining the game and bird reservations. Many important bird refuges are without regular or even part-time warden protection.

The Hawaiian Islands Bird Reservation is an example of an exceedingly interesting and important wild life area for which it has been impossible to provide regular warden service. On certain of these islands were species of birds found nowhere else in the world, some of which have already become extinct, while others, including the Hawaiian teal, have been reduced to slender remnants. The islands are also breeding places for large colonies of interesting sea birds. Poachers have raided the islands, and introduced rabbits have destroyed most of the vegetation on the larger islands, thus rendering them barren and contributing indirectly to the adverse conditions for the birds. Efforts to eradicate the rabbits have been made, not with entire success, however, at least on some of the islands, and the restoration of the vegetation is an important problem. Two resident wardens are urgently needed, with provision for their transportation from island to island.

The wild life of the Aleutian Islands Bird Reservation, which extends in a chain for about 1,000 miles southwestward from the end of the Alaska Peninsula and embraces many large and small islands, has not been fully studied. Requests for the utilization of some of the islands for domestic stock grazing, fur farming, and other commercial pursuits require careful consideration in order to safeguard the interests of the natives and to prevent possible harmful effect on the mammal and bird life. Funds are urgently needed for regular warden service and for a sea-going vessel to make regular visits to the more important of the islands. More complete knowledge of the wild life of the reservation and of conditions affecting it is essential to efficient administration.

Numerous areas have been proposed for game and bird reservations, and while many of them are no doubt suitable, funds with which to investigate them have not been available.

CONTROL OF HARMFUL WILD LIFE

Certain forms of wild life are injurious to agriculture, horticulture, stock raising, forestry, and wild game, and against these control measures are necessary. The principal offenders are predatory animals, injurious rodents, and some few species of birds. The control of surplus game is discussed elsewhere.

Predatory animals, including wolves, coyotes, mountain lions, and bobcats, are destructive chiefly to sheep and lambs, calves, pigs, and poultry, and make serious inroads on the stocks of wild-game mammals and ground-nesting game and insectivorous birds.

Rodents, such as prairie dogs, ground squirrels, pocket gophers, jack rabbits, rats, and mice, interfere seriously with crop production and forestry, and cause much concern in farming and range districts, particularly when adjacent to infested public lands. Moles and other small forms have raised local problems.

The progressive improvement in control methods and the development of a trained leadership with experienced hunters, trappers, and poison operators have produced gratifying results over both large and small areas.

Of Federal funds expended during the year for control measures, approximately $21,500 was used for investigational work, particularly to further the development of predatory-animal and rodent poisons; $274,400 in the destruction of predatory animals; and $165,600 in the destruction of injurious rodents and other small-animal pests. Organized field work was carried on in 17 States, the legislatures in 11 of which had provided cooperative funds in the amount of $514,200, besides $497,500 raised by cooperating wool associations, counties, and individuals. Of these funds, $370,100 was expended for control of predatory animals, and $641,600 in rodent control. Approximately $1,473,300 was used under the leadership of the Bureau of Biological Survey for control work during the year, of which more than $1,000,000 was in cooperative funds and less than half a million from the Federal Treasury.

By specially prepared exhibits at State fairs and at stockmen's and sportsmen's shows, the economic status and recreational values of wild-animal life were shown, particularly the necessity for reasonable control operations along with conservation and wise utilization.

PREDATORY-ANIMAL CONTROL

The resources to meet the problems of predatory-animal control as they exist in the range States are far from adequate. Other States west of the Mississippi have requested that cooperative campaigns against predatory animals be instituted within their borders. To meet the problems as they exist calls for a more equalized expenditure on the part of the Federal Government with relation to cooperative funds, particularly since predatory animals still exist in large numbers on the Federal domain, which serves as a breeding ground from which private and State lands are infested. Thorough control of these animals can be brought about only by coordinated action of Federal, State, and private agencies. Organized procedure in controlling predatory animals, as developed by the Biological Survey, has stood the test of time. Most noteworthy successes are recorded in the case of the gray wolf. The control of the others, however, foremost of which is the coyote, demands more adequate Federal funds to lower the $20,000,000 bill for depredations annually inflicted upon growers of livestock and poultry.

Eradication campaigns were carried on in all States from Montana to Texas and westward, and in South Dakota and Illinois. During the fiscal year 47 big gray wolves, 154 red wolves, 37,887 coyotes, 246 mountain lions, 3,677 bobcats, 41 Canada lynxes, and 186 predatory bears were reported as killed, but coyotes were actually destroyed in larger numbers, 53,000 additional being the estimated number that were killed by poison but not found. The destruction of these predatory animals has effected an estimated livestock saving of $5,500,000.

The methods employed in these campaigns included poisoning, trapping, and den hunting and the use of trained dogs and the rifle. Poisoning procedure, however, as developed by the survey, is proving the speediest means of control, particularly of the coyote, in areas where heretofore this animal has caused great losses to the ranchman and stock grower.

During the past three years charges have been made by private trappers and fur interests that predatory-animal control through poison campaigns is responsible for the depletion of fur bearers. An investigation of the situation was suggested by the National Association of the Fur Industry, to which the bureau agreed. A member of the department of zoology of the University of California was therefore employed by the National Association of the Fur Industry to conduct this investigation during the coming year, and field men of the survey have been instructed to extend him every possible aid.

The coyote is a major problem on the western stock ranges and its control will call for long-continued and persistent cooperative action. Gray wolves, once responsible for heavy depredations, especially among cattle and horses, are now sufficiently reduced in numbers to cause but little concern, though it is still necessary

to employ trained hunters for their control, particularly along the international boundaries, where they cross from Mexico to Texas, New Mexico, and Arizona, and from Canada to the northern tier of States.

The hunting of mountain lions has been continued over infested stock ranges and wild-game regions. In Arizona the total lion kill for the year was 118, bringing the grand total for that State in 11 years to 702. This represents a large saving of beneficial forms of wild life, considering that one mountain lion may destroy at least 100 deer yearly.

Bobcats and lynxes, of which 3,718 were taken during the year, are the source of considerable loss to livestock, especially sheep during the lambing season, but are readily brought under control by trained hunters. Their closely allied cousin, the house cat, is reported more and more each year as being exceedingly destructive to song and insectivorous birds in cities and to game birds in fields surrounding rural communities. Thus far, the Biological Survey has taken no active steps toward aiding in control of destructive house cats, but upon request has furnished advice on known methods.

Considering the bear a game animal, the bureau has instructed its predatory-animal field force to make no effort toward its control, except of individuals known to be stock killers. Before attempting to take any individual bear, evidence that it has become addicted to killing stock is first definitely established. Since the work was begun in 1915, it has been necessary to kill only 1,191 stock-killing bears in the entire West. Many of the skins and skulls of predatory bears thus killed have been deposited in scientific-study collections in various museums throughout the United States.

CONTROL OF INJURIOUS RODENTS

Rodent-control operations were carried on under Biological Survey leadership in all States west of the Great Plains, including South Dakota, Kansas, and Texas, and east of the Mississippi River in Kentucky and all but six of the States north of the Ohio and Potomac Rivers.

In the United States, native and introduced rodents cause millions of dollars annual damage. To combat their destructiveness has called for intensive cooperative poisoning campaigns. In such campaigns during the year against prairie dogs and ground squirrels, 1,017,309 acres of Federal land and 13,974,659 acres of State and private land were treated, a total of 14,991,968 acres. Altogether 1,312 tons of poisoned grain were used, besides 405,191 pounds of carbon disulphide and 146,035 pounds of other fumigants, mainly powdered calcium cyanide, in completing the kill of prairie dogs and ground squirrels where poison had failed in the first and second treatments. More than 127,000 ounces of strychnine were used for poisoned baits for both predatory animals and rodents in Federal and cooperative control campaigns during the year. The saving in crop and range grasses through rodent-control operations is conservatively estimated at $5,700,000. Important as is this accomplishment at a total expenditure of less than one-seventh this amount, barely a beginning has been made in rodent control.

Cooperative control campaigns have been given substantial encouragement, and during the year much progress was made in eradicating rodents where heretofore they have been seriously destructive. This work was done in cooperation with State departments of agriculture and agricultural colleges, county agricultural agents, livestock associations, and the Extension Service, the Forest Service, the Office of Indian Affairs, and the Bureau of Reclamation, and with individual farmers and stockmen. These agencies working with the Bureau of Biological Survey have made it possible to reach ranchers, wheat growers, orchardists, stockmen, poultrymen, truck gardeners, bulb growers, and nurserymen in solving their rodent problems.

An encouraging feature brought out in all these cases is that practically every agency in the agricultural section stands ready at all times to cooperate in all proved methods of eradication. From the financial viewpoint alone this cooperative spirit is of the greatest importance, for without it little headway could have been made. This is obvious, considering that during the past year in one western State the work of 3,834 cooperators, figuring the labor cost alone in distributing poison baits, represented an outlay of $60,000, which is approximately three times the total annual Federal allotment for rodent control in that State.

PRAIRIE DOGS AND GROUND SQUIRRELS

Gratifying progress has been made in eradicating prairie dogs and ground

squirrels from range and farming lands. There remains, however, serious infestation on the national-forest lands and other public domain, on which little headway can be made with available funds. The carrying capacity of infested national-forest lands is reduced approximately 25 per cent by the rodents. The national forests and other Federal lands often are the source of infestation of private agricultural land and other areas. Typical of such condition is the invasion of the upper Arkansas Valley in Colorado by the Wyoming ground squirrel, mainly from national-forest lands. Another striking example is furnished in Montana, where vast areas of Federal lands, mainly mountainous, forested, or broken in character, frequently border on private holdings. These areas are chiefly on national forests, Indian reservations, and vacant public lands. In the Bitterroot Valley, where Rocky Mountain spotted fever is spread by ground squirrels, and in California, where ground squirrels carry bubonic plague, it becomes also a matter of human health.

It is impracticable, however, for the survey to control the rodent infestation on these Federal lands, even though it has expert personnel for systematically projecting a series of poison campaigns. Its limited resources must for the present be used in cooperative-control operations on State and private lands. A definite, systematized program for rodent eradication is called for over the public domain, including practically every national forest west of the Continental Divide. It is the definite obligation of the Federal Government to adopt such a program.

POCKET GOPHERS

Control and eradication of pocket gophers were conducted in practically all the range States. Serious damage is done annually by these rodents to dikes, bulb beds, orchards, and hay lands, particularly alfalfa. Much of the loss is being gradually eliminated through demonstrations by rodent-control specialists, who are showing interested farmers how to rid their lands of these rodents.

As typical of the damage pocket gophers do there may be cited the case of 5,000 acres of productive farm lands in Texas ruined for peanut or sweet-potato production by these rodents. On one farm where 387 peanut vines had been killed by pocket gophers, it was found that the loss, checked against untouched vines, was at the rate of 7½ bushels an acre. In another area from which these rodents had been eradicated, the farmers again planted sweet potatoes, and by the end of May, from areas formerly unproductive, had shipped seven carloads, netting them approximately $6,650.

In a nursery near Yuma, Ariz., 30,000 pecan trees were doing well until pocket gophers got in and destroyed 28,500 of them. As each tree was valued at more than $1, the owner realized that something must be done at once and called on the local rodent specialist of the bureau for assistance. A trapping demonstration was given at the nursery, and when all the pocket gophers had been caught it was evident that not more than 55 had been involved in the destruction.

Cooperative measures were successfully applied in Santa Cruz County, Ariz., whereby 72 boys entered a pocket-gopher contest. After instruction these boys caught 2,011 pocket gophers on 2,300 acres. The tails of the rodents were turned in as evidence of each boy's catch. In addition $27 was awarded in prizes for high catches by groups, and prizes also were awarded for the best essays on "Why pocket gophers should be controlled in Santa Cruz County."

JACK RABBITS

Early in the year cooperative control of jack rabbits was given added impetus when, through the efforts of field men of the Biological Survey, a western fur company formulated a plan whereby the counties would pay a bonus of 2 cents each for all jack-rabbit skins turned in, and the company would pay in addition, through the county, a bonus of 8 cents for each marketable skin, making a total of 10 cents to the farmer. This places jack-rabbit control on a commercial basis and will tend to simplify the problem. The eradication of the jack rabbit by this method gives the farmer immediate financial returns for his efforts and in addition affords protection to his crops. As a result, more than $40,000 was realized by farmers in Colorado, $27,000 in Idaho, $15,000 in Kansas, and $84,000 in South Dakota, and lesser returns by farmers in Wyoming, Utah, Montana, and Arizona.

PORCUPINES

The seriousness of porcupine devastation in forests, including young

plantings, is shown in southwestern Colorado, where on one national forest some 200,000 acres are so badly infested that porcupines are alleged to be more destructive to the trees than any other agency. Extensive porcupine-control operations are needed over many of our national-forest lands.

HOUSE AND FIELD MICE

A plague of house and field mice occurring last winter in Kern County, Calif., necessitated control work of a cooperative nature between State, county, and Federal agencies. More than 17,000 acres of the area infested were treated, and more than 20 tons of poisoned grain were used in bringing the plague under control.

THE BROWN RAT

Rats constitute a great economic menace, although warning is continually sounded and control operations undertaken. Many demonstrations for the control of rats were made through the year and in most sections proved popular, as is shown by the large average attendance at 223 demonstrations given in the Eastern States. A Farmers' Bulletin entitled "Rat Control," issued during the year, furnishes up-to-date information relative to effective measures. Rat control in cities is being given added attention through publicity, demonstrations, the organization of antirat campaigns and by investigations of places that encourage rat infestation, followed by recommendations to city officials and others concerning necessary action.

OTHER HARMFUL MAMMALS

Moles constitute a most difficult problem in Oregon and Washington, particularly where the bulb-raising industry is increasing rapidly, and with it a keen realization of the damage indirectly wrought by these mammals. Demonstrations for the control of moles were made, the use of suitable traps was recommended, and at the close of the year experiments in the effectiveness of fumigants to mole runways were being made. A revised edition of the Farmers' Bulletin entitled "Moles as Agricultural Pests" was issued during the year.

INJURIOUS BIRDS

In curtailing the injurious activities of birds, the principle of local control has been adhered to. No species is wholly injurious, nor is any so generally harmful that a country-wide campaign for its control is warranted. Certain species, however, especially those of gregarious habits, may locally become a source of great damage. Through demonstrations of field methods and by correspondence, aid has been given to persons troubled by the depredations. Magpies, English sparrows, blackbirds, and crows have received considerable attention and the methods of control recommended have been found generally successful. A technical bulletin on the distribution, economic status and methods of control of the magpie was ready for publication at the end of the year. Directions for breaking up objectionable bird roosts, composed usually of blackbirds, starlings, or martins, have been given to many persons requesting relief from their noisy and oftimes untidy gatherings.

ANIMAL-BORNE DISEASES

TULAREMIA

As in the past fiscal year, precautionary measures have been taken in jack-rabbit control to prevent the spread of tularemia. Reports from Nevada, however, state that 18 persons contracted this disease by handling rabbits or being bitten by ticks during the year. Some of these cases were severe and lasted two or three months, while in others the victims apparently recovered in two weeks' time. In Colorado a predatory-animal hunter of the Biological Survey contracted tularemia from handling jack rabbits after a rabbit drive, and for a long time his life was despaired of.

RABIES

Each report on rabies in wild animals as received was given careful attention, and where rabies-infected coyotes were known to occur in any area, a trained hunting force was quickly concentrated, thus preventing a possible spread of infected animals to other districts.

Sporadic outbreaks were reported in Nevada, Utah, Washington, and Colorado during the year, the majority of them caused by coyotes and dogs, but some by house cats.

LAW ENFORCEMENT AND CONSERVATION POLICIES

The year records an increased respect on the part of sportsmen and

others for Federal and State laws for the conservation of wild life. Although thorough enforcement of Federal laws has not been possible because of insufficient resources, much has been accomplished through the hearty cooperation of State officials, game-protective organizations, and interested sportsmen. Spring shooting has been reduced to a minimum, as has also the wholesale slaughter of game for market. These accomplishments are alone sufficient to justify the migratory-bird treaty act. Violations of this and other conservation laws, however, still occur, but the real sportsmen have been convinced of the need for their observance. Furthermore, an increased number of United States district courts and district attorneys have shown particular interest in the enforcement of the migratory-bird treaty act, with the result that in many localities violations have materially decreased.

FEDERAL AND STATE COOPERATION

By personal contact during the past year a closer relationship has resulted between State and Federal authorities engaged in the protection of game. Increased cooperation has also been attained by continuing the policy of appointing State game wardens as Federal deputies in those States where the laws permit. The United States game wardens have assisted the State wardens in enforcing their own statutes. Cases turned over to State authorities for prosecution resulted in the collection by the States of more than $5,400 in fines. In some instances the States have commissioned United States game wardens as State wardens.

For the better information of officials regarding the extent of hunting throughout the country, the number of hunting licenses issued by the several States was compiled and released through magazines, newspapers, and otherwise. The tabulation showed for 44 States that 5,150,000 hunting licenses were issued during the season 1925–26, and the revenue accruing therefrom to the States amounted to $6,800,000. The bulk of hunting-license money is used by the States for the protection and propagation of game and for the establishment of wild-life refuges.

For purposes of better cooperation between Federal and State authorities engaged in work for the conservation of birds and game, the annual directory of national, international, and State bodies was printed and distributed during the year as a circular of the department, and the annual summaries of the game and fur laws of the United States, Canada, and Mexico were published in the Farmers' Bulletin series, the summaries being in demand by conservationists, hunters, and trappers generally. A pamphlet containing the text of the treaty between the United States and Great Britain for the protection of migratory birds in the United States and Canada, the migratory-bird treaty act to give effect to the treaty, and the revised regulations promulgated thereunder was published during the year. It contains also the text of the Lacey Act, regulating interstate commerce in game, the Federal statute protecting wild animals and birds and their eggs on Federal reservations, and provisions of the tariff act regulating importation of wild birds and their plumage.

In spite of the increased number of hunters and the fact that automobiles and good roads make almost every hunting section readily accessible, game appears to be holding its own in most parts of the country and to be on the increase in some. A serious problem, however, is presented with regard to wild fowl, the feeding grounds of which are menaced by drainage operations, by lack of rainfall in certain places, and by diseases and the encroachments of industry on former game haunts. These have undoubtedly operated to cause a shortage of game birds in certain sections. All things considered, however, with a very large element of the public awake to the needs of wild life, the prospect for the future of both migratory and nonmigratory game is bright.

MIGRATORY BIRD TREATY ACT

HEARINGS

Two public hearings were held during the year on proposed changes in the regulations under the migratory-bird treaty act (40 Stat. 755), affecting the use of sinkboxes on rivers and bays. A conference also was called by the Secretary to discuss methods to restrict further the killing of migratory wild fowl, and was largely attended by sportsmen and conservationists from many sections of the country. At the hearings differences of opinion were expressed in regard to shortening the season on migratory waterfowl, reducing bag limits, set-

ting rest days, and using sinkboxes. Action was deferred on the question of shortening seasons and reducing bag limits pending a further investigation of conditions and the results of the contemplated waterfowl census.

AMENDED REGULATIONS

The Migratory Bird Treaty Act Advisory Board held its annual meeting in Washington, D. C., in December and recommended changes in regulations, of which the following were adopted by the Secretary and approved by the President:

Advancing the open season on waterfowl, coots, gallinules, and Wilson snipe, or jacksnipe, in northeastern California and making the season in five counties in northern Idaho conform with that in Montana, where climatic conditions are similar; prohibiting the use of sinkboxes, or batteries, except in coastal waters, and there only when placed not less than 700 yards from the mainland or an island at ordinary high tide and not less than 700 yards from any other sinkbox (battery); prohibiting the use of airplanes, power boats, sailboats, or any other floating devices for the purpose of concentrating, driving, rallying, or stirring up migratory waterfowl; closing the season on greater and lesser yellowlegs for two years, until August 16, 1929, thus making jacksnipe and woodcock the only shore birds that may be hunted during the season 1927–28; and reducing the bag limit on woodcock from six to four a day.

VIOLATIONS AND PENALTIES

The disposition of cases of violation of the migratory bird treaty act during the year is shown as follows:

Pending cases		372
New cases		484
Total		856
Convictions	273	
Dismissed	33	
Verdicts of not guilty	20	
No bills	3	
Nolle prossed	39	
Prosecution abandoned	26	
Permission to file information denied by court	56	
Death of defendants	3	
Total disposed of		453
Undisposed of		403

One hundred and seven cases reported by United States game wardens were not forwarded for prosecution, for lack of sufficient evidence, youthfulness of the accused, because adequate fines had already been imposed in State court, or other satisfactory reasons.

One case tried before a jury resulted in a conviction and the imposition of a substantial fine. Federal judges imposed jail sentences in 15 cases, and fines ranging from $1 to $250, totaling $6,427.10. Migratory waterfowl and mounted specimens illegally possessed or unlawfully killed valued at more than $2,000 were seized during the year. Among the violations for which offenders were punished may be mentioned the following: Shooting waterfowl from a power boat, selling waterfowl, killing ducks in closed seasons, hunting ducks after sunset, killing and trapping migratory insectivorous birds, and killing nongame birds on which there is no open season. The jail sentences and fines were in most cases sufficient to act as strong deterrents to game violators.

SCIENTIFIC AND OTHER PERMITS

Permits issued during the year to collect migratory birds and their nests and eggs for scientific purposes numbered 224, which, with 1,281 valid until revoked, made a total of 1,505 outstanding. Scientific possession permits, issued mainly to taxidermists, number 293. For the possession and sale of waterfowl for propagating purposes, 3,311 permits were in effect, of which 870 were issued during the year.

Of reports received from approximately 2,500 permittees raising wild fowl for propagation, 962 show 35,552 wild ducks and 3,725 wild geese raised in captivity. Practically all the ducks raised were mallards, there being less than 500 wood ducks and a scattering of pintails, teals, redheads, widgeons, and gadwalls. The geese were almost exclusively Canada geese, with small numbers of snow, blue, and Hutchins geese. Large numbers of the birds were undoubtedly released, thereby augmenting the country's supply of wild fowl.

PERMITS TO KILL INJURIOUS BIRDS

Orders permitting the killing of certain migratory birds when found injurious to valuable fishes, particularly at trout ponds, were issued by the Secretary, effective in New Hampshire and Wyoming. As the orders issued were based upon scientific information regarding the habits of the birds, they should, without seriously injuring the species, stop local depredations upon valuable fishes.

For the purpose of protecting the rice crops in certain southern States from the depredations of bobolinks, commonly known as reedbirds or ricebirds, the department, under an order of the Secretary, for several years has permitted the hunting of these birds each fall in Pennsylvania, Delaware, Maryland, the District of Columbia, Virginia, North Carolina, South Carolina, Georgia, and Florida. An investigation conducted during the year indicated that general hunting of bobolinks was no longer necessary or advisable for the protection of rice crops. The order, therefore, was modified in March, and has the effect of placing a close season throughout the year on bobolinks, except in North Carolina, South Carolina, Georgia, and Florida, where the birds may be killed only under permit issued by the Secretary and countersigned by the chief official in charge of the enforcement of the fish and game laws of the State in which it is effective.

THE LACEY ACT

INTERSTATE COMMERCE IN GAME

Administration of the Lacey Act (31 Stat. 187–188 and 35 Stat. 1137), which regulates interstate commerce in game, has had the effect of uncovering large numbers of violations of State laws relating to fur animals, and the violators have been punished generally through the process of State courts. Additional Federal authority to permit wardens to seize illegally transported skins and furs is greatly needed, and if the greatest good to wild life is to be obtained Federal control should be extended to cover interstate shipments by other than common carrier.

Cooperation with the State authorities in the enforcement of State laws with reference to illegal interstate traffic in the skins of fur-bearing animals was continued on an extensive scale, and approximately 4,000 apparent violations of State laws were referred to State officials for investigation. This number exceeded by about 80 per cent the survey's previous record for any one year along these lines. Settlements effected in State courts in 352 of the cases resulted in fines and costs aggregating $14,292.70, and in the confiscation of a number of valuable skins, including 54 of beaver.

Five cases involving violations of the Lacey Act were reported for prosecution during the year, four of them being disposed of in Federal courts with fines aggregating $50. Sixty Federal investigations involving possible violations were closed, mainly for the reason that the shipments were found to have been legally made. At the close of the year approximately 350 cases were pending.

During the year assistance has been given to several States in drafting revisions of their laws relating to fur animals, particularly with reference to beaver, in order that they might benefit by the supplemental authority of the Lacey Act in the enforcement of their laws for the protection of these animals. This new provision, enacted by several of the legislatures during the 1927 sessions, should render cooperation with such States much more effective and produce correspondingly satisfactory results.

IMPORTATIONS OF FOREIGN BIRDS AND MAMMALS 1927

An important provision of the Lacey Act regulates the importation of foreign wild birds and mammals, through the issuance of permits. The number issued during the year was 1,067, an increase of 34 over the preceding year, and inspections of shipments at ports of entry increased from 295 to 337. For the entry of 61 miscellaneous birds at Honolulu, Hawaii, 11 additional permits were issued. The total number of foreign birds imported was 572,927, of which 12,883 were without permit.

Mammals.—Permits for the importation of mammals included 4,242 foxes from Canada. Following are the figures for the past five years: 7,809 in 1926; 8,424 in 1925; 4,781 in 1924; 2,753 in 1923; and 2,064 in 1922.

Two South African mongooses and 1 small fruit-eating bat (*Pteropus medius*) were imported during the year, and were purchased by the Philadelphia Zoological Gardens. These were brought in through inadvertence, but as the mongooses did not represent species prohibited from entry they were permitted to remain in captivity.

The only case of a doubtful species that might become injurious, was a shipment of 10 European hares that arrived at the port of New York on December 18 for a rod and gun club in Maryland. As European hares have proved injurious to horticultural and agricultural interests in the past, and as these animals were consigned to a point near an important apple-growing district, a permit for their

entry was withheld, and they were killed and sold for meat.

A number of mammals of more than general interest were received during the year from Asia and Africa, notably Pa-wa, the first white elephant ever brought to the United States, which arrived at New York from Siam on November 15. Captured in 1919 when about 1½ years old and less than 4 feet in height, Pa-wa is now 9½ years old and weighs 2½ tons and is on exhibition in one of the larger circuses. In its native home the white elephant is regarded as sacred.

Among other interesting mammals were a number of species secured by the National Zoological Park through the Smithsonian-Chrysler Expedition, including several rare forms seldom seen in captivity. Among the more important were two young giraffes, an impalla, a greater kudu, several species of antelopes and lemurs, and some of the rarer smaller mammals, such as mice of genera peculiar to Africa, and an elephant shrew.

Game birds and their eggs.—Importations of game birds included 85,141 Mexican quail; 5,518 Hungarian partridges, and a few waterfowl and tinamous. A considerable demand developed for Hungarian partridges, much more than could be supplied by available stock; the birds received were distributed mainly in Alabama, California, Colorado, Illinois, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, South Dakota, and Virginia.

During the year five permits were issued for the importation of 530 eggs of game birds, chiefly of pheasants from England, and of ducks and grouse from Alberta. The largest shipment was one of 300 pheasant eggs from England on May 18 destined for a point in Pennsylvania.

Foreign cage birds.—Traffic in cage birds has been increasing steadily for several years since the war, and, as usual, formed the principal part of the importations. Canaries and parrots were brought in in large numbers, the former numbering 374,895, and the parrots 60,886. Among the canaries were several fancy breeds. Parrots have come in in large numbers and in considerable variety. Among the rarer species were 3 hawk-head parrots (*Deroptyus accipitrinus*), 2 short-tailed parrots (*Graydidasculus brachyurus*), 24 red-tailed parrakeets (*Pyrrhura emma*), and 10 red-fronted love birds (*Agapornis taranta*). Some rarer species of love birds of the genus Agapornis, which, up to a few years ago, had never been imported into America, have been received in considerable numbers from East Africa. Among other rare birds have been a shoebill stork, the second specimen ever imported, the first being obtained by the New York Zoological Park also during the year, and several species of guinea fowl, francolins, doves, birds of prey, hornbills, glossy starlings, and weaver birds, brought by the Smithsonian-Chrysler expedition. There were also 8 copper pheasants, formerly imported frequently but since the war in very small numbers, 10 chukar partridges, several birds of paradise, including the red bird of paradise (*Uranornis rubra*), king bird of paradise (*Cicinnurus regius*), magnificent bird of paradise (*Diphyllodes magnificus*), and 12 wired bird of paradise (*Seleucides ignota*).

Traffic in native cage birds.—In spite of the provisions in State laws prohibiting possession and sale of native cage birds, efforts are constantly made by certain dealers to extend the traffic in mocking birds, cardinals, nonpareils, and some others. During the year an unusual number of applications were received for importation permits for these species from Mexico, and the total number of birds authorized was 1,509. Once imported they are shipped from one point to another and frequently are offered for sale in States in violation of local laws. If investigation is made and it develops that the birds were imported, the department is severely criticized in directly aiding in violations of the State law. For this reason importers are required to state beforehand the destination of the shipment, and authorization from the State to which the birds are consigned must be filed with the application for the importation permit. Even with these precautions shipments increase and criticism often develops.

It is highly desirable that there be more uniformity in State laws restricting the caging of native species and that local authorities scrutinize each application with the greatest care rather than treat requests for sale and possession of native birds as routine matters. None of the species most in demand by the bird trade comes within the provisions of the migratory bird treaty act, and the trade is consequently regulated entirely by State laws.

Quail from Mexico.—Important changes were made in the importation of quail during the year. The Mexi-

can Government reduced the export tariff on the birds to 10 cents each and granted generous concessions to importers located at ports of entry in Texas. As a result more quail than ever were brought in, the total number being 85,141, of which 29,949 were imported at Eagle Pass, 32,851 at Laredo, and 22,341 at Brownsville.

This season a radical departure was made in the issuance of permits by authorizing the inspectors of the Bureau of Animal Industry who examined the birds at the ports of entry to issue permits for the exact number brought in. In this way all delay was obviated and any uncertainty as to coordinating the number on the permits and those in the shipments. The system worked smoothly and seems to have given satisfaction to the shippers. Inspectors of the Bureau of Animal Industry examined all shipments at the border but reported no quail disease.

Weekly reports were made on the number of quail entered, their condition, and details as to shipments, thus furnishing a complete check on the destination of the entries. A larger proportion of the birds than usual was shipped to the Southern States, most of them to points south of Pennsylvania and the Ohio River, as follows: Alabama, 11,741; Oklahoma, 10,074; Georgia, 9,444; Kentucky, 7,086; Texas, 5,928; South Carolina, 4,718; Missouri, 4,332; North Carolina, 3,406; Maryland, 3,070; Florida, 2,624; Kansas, 2,499; Virginia, 1,574; Tennessee, 1,058. Among northern States, in addition to several small shipments, Illinois received 6,653; Pennsylvania, 3,904; and New York, 2,113.

BIRD-REFUGE AND ALASKA WILD-LIFE LAWS

Other laws administered by the Biological Survey, to some of which reference has already been made, are the law protecting wild animals and birds and their eggs on reservations (43 Stat. 98); the Upper Mississippi River Wild Life and Fish Refuge act (43 Stat. 650), in cooperation with the Bureau of Fisheries; and the Alaska game law (43 Stat. 739), in cooperation with the Alaska Game Commission, on which the Bureau of Biological Survey is represented. The Secretary has approved regulations under these acts during the year with respect to reservations, and to birds and game and fur animals in Alaska, all in the interest of better wild-life administration.

Regulations for the Upper Mississippi Refuge were issued jointly by the Secretaries of Agriculture and Commerce and prescribe the conditions under which hunting and other recreational activities, including fishing and camping, will be permitted, and provide against damage from camp fires. The general plan is to allow the public the freedom of the refuge as far as possible, consistent with the protection of its wild life.

Revised regulations under the Alaska game law, adopted by the Secretary after recommendation by the Alaska Game Commission and submission by the Biological Survey, contained only such alterations as were considered necessary to meet changing conditions and to correct defects after the first year of its operation. Changes affect the seasons and limits on caribou, black bear, and beaver. Violations of the law have drawn some exemplary penalties, including $500 for an alien fur dealer operating without a license; $25 for a canning company serving game to its employees; $25 each and jail sentences of 60 and 90 days, respectively, for trapping beavers out of season; $50 for killing a female deer; and $250 and 90 days in jail for killing a mountain sheep on a protected area. Public approval of the law, which has been in operation only since August, 1925, is shown by the strong support given it by the local courts, and the unusually high average of penalties and jail sentences imposed, and it is felt that excellent results are being accomplished.

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